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INSECTICIDES FOR USE IN LIVESTOCK-DIPPING VATS

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During the last 5 years millions of cattle, sheep, and goats in the southern United States have been treated in dipping vats to control ticks and insects. Some ranchers still use the soluble-arsenic dip originally introduced for cattle tick control, but the arsenic has largely been displaced by modern insecticides.

The insecticides now most widely used in these vats are toxaphene and a mixture of DDT and BHC. Toxaphene wettable powders formulated for use in dipping vats have recently become available, and research indicates that they can be safely used. The Department has not previously recommended emulsion dips of toxaphene or DDT-BHC, because early experience showed that they were hazardous. However, during the last few years commercial formulations have been greatly improved, and it is now possible for cattle to be safely dipped in certain toxaphene emulsions.

Spraying the insecticides with a power sprayer is still the preferred treatment for general use, but since thousands of dipping vats are currently being used to treat livestock with toxaphene and DDT-BHC, information is presented herein to guide manufacturers who formulate insecticides for the dipping-vat market. Instructions for use in the vats are also given.

1/ J. C. Clark, Rowland Richards, and B. I. Sparr conducted the field and laboratory tests under the direction of R. C. Bushland. H. V. Claborn, of the Section of Insecticide Investigations, guided the chemical studies. R. D. Radeleff, of the Animal Disease and Parasite Branch, advised the workers and conducted the basic experiments on toxicity of dips to farm animals.

Since most cattle-dipping vats have a capacity of 2,000 gallons or more, they are expensive to charge. Owners do not pump them out and clean them during a dipping season, but merely add water and insecticide to compensate for that taken out by the stock. Therefore, although fresh dip may be added almost every time the vat is used, some of the original dip remains in the vat for about 6 months.

Before 1950 there were some fatalities among the dipped livestock due to deterioration of the emulsion on standing. The animals could be safely treated in freshly mixed dip, but as it aged the particle size of the oil phase increased, leaving a heavier deposit on the hair of dipped animals (Sparr et al. 5). There is only a small margin of safety between the amount of insecticide required for control of ticks and the amount that is toxic to some farm animals (Radeleff and Bushland 3). The deposits from deteriorated dips exceeded this margin of safety. On this account toxaphene was not recommended for use in dipping vats until sufficient evidence was available that it could be used safely.

During the seasons of 1951, 1952, and 1953 the performance of commercially formulated insecticides in dipping vats was closely observed by workers of the Kerrville, Tex., laboratory. These dips were used for the control of insects and ticks affecting cattle, sheep, and goats. Each time the vats were used dip samples were taken for chemical analysis, and hair samples were clipped from cattle before and after dipping and analyzed for the amount of insecticide. Microscopic examinations of dip samples to determine particle size were also made.

Toxaphene Emulsifiable Concentrates

Emulsions made with two commercially formulated toxaphene emulsifiable concentrates performed successfully. In addition to these observations on limited numbers of vats, the cooperating companies made available the results of their own field experiments and their reports on the performance of the dips as used by livestock owners. It was concluded from these studies that the physical characteristics of dips from even the best commercial formulations change during 6 months' use.

In fresh mixtures the oil phase is practically colloidal, and very few particles can be observed at 960 diameters magnification. As the dips age these colloidal particles coalesce to form visible droplets, and then these minute droplets fuse to produce still larger droplets. As the particles increase in size, they are more readily taken out by the hair of cattle swimming through the vat. In freshly mixed dips containing 0.5 percent of toxaphene, cattle received deposits averaging about 1 percent of the weight of the hair. At the end of the dipping season, although the concentration of insecticide had been maintained at 0.5 percent through the addition of

appropriate amounts of fresh concentrate and water, the deposits on the hair increased 50 percent, to about 1.5 percent of the weight of the hair. This is considered the maximum deposit that can be safely tolerated by the most susceptible farm animals. These results were observed on the very best formulations. Some inferior formulations caused excessive deposits after only 2 weeks' aging.

Laboratory Evaluation

It is recognized that the dip manufacturer cannot check his product by the elaborate field studies outlined above, but some kind of a laboratory procedure is required to check on dip stability. At the Orlando, Fla., laboratory Sparr and Bowen (4) worked on emulsion-stability specifications in connection with their research to develop insecticides for clothing impregnation. One of the leading manufacturers of toxaphene emulsifiable concentrates has made intensive laboratory studies of emulsion stability. At Kerrville the Orlando procedures have been combined with some of the features developed by the industrial cooperator to establish a technique for evaluating the emulsion stability of prospective livestock dips. That procedure is described below.

Apparatus.--The emulsibility tube is a 22-mm. outside diameter Pyrex tube (Corning Code No. 234220) 4 feet long, joined to a 15-ml. conical centrifuge tube (Corning Cat. No. 8080). Although a ground-glass connection has been used, a 1-inch length of Tygon tubing of 1/2-inch inside diameter and 3/32-inch wall thickness makes a satisfactory connection. The mouth of the centrifuge tube is fitted flush with the end of the 4-foot tube. Centrifuge tubes graduated in 0.1-ml. divisions are used for accuracy in making the sedimentation readings.

A tipless measuring pipette, prepared by cutting off the tapered tip below the 5-ml. mark and grinding the end to a smooth, flat surface, is used for introducing the toxaphene concentrate into the emulsibility tube.

Test Waters.--Distilled water, a synthetic soft water (Lange 1), and a synthetic hard water (Navy Department 2) are used. The type and composition of the waters are given below.

Type of water	Hardness (p.p.m. of calcium carbonate)	Composition, grams per liter		
		Calcium chloride	Sodium bicarbonate	Magnesium chloride
Distilled	None	--	--	--
Naturally softened	20	0.0094	0.8000	0.0103
Navy hard	500	.2345	--	.2680

Procedure.--The test is conducted at $80^{\circ} \pm 5^{\circ}$ F. The insecticide concentrates and the test waters should be at room temperature.

Hold the emulsibility tube vertically in a rack and fill it with test water to a mark 2-1/2 inches below its mouth. About 350 ml. is required. Pipette sufficient concentrate to give a 0.5-percent toxaphene emulsion into the tube with the tipless pipette, holding it vertically so that the delivery end is in the same plane as and in the center of the mouth of the emulsibility tube. Note the rapidity and degree of disintegration of the concentrate, and make observations for bottom creaming or breaking of the emulsion after 1 hour, 24 hours, and 30 days.

Performance Specifications.--The results expected from this evaluation procedure are based on the performance of the two commercial concentrates that have proved satisfactory in ranch dipping vats. One of those concentrates contains 50 percent of toxaphene, 10 percent of an emulsifying agent (a blend of nonionic and anionic emulsifiers), and 40 percent of a petroleum distillate similar to Stoddard's solvent. The other concentrate contains 61 percent of toxaphene, 12.5 percent of emulsifier (a blend of nonionic and anionic surfactants), and 26.5 percent of kerosene.

The insecticide should disperse spontaneously in all test waters, with the oil phase breaking up as it sinks. No oil droplets should reach the bottom of the tube. After 1 hour's standing there should be no more than a trace of bottom cream. After 24 hours' standing there should be no more than 0.2 ml. of bottom cream, and any cream should resuspend completely on one inversion of the tube. The tube should be stoppered and left to stand for 30 days. At that time the creaming should not be appreciably greater than after the first 24 hours.

Only those concentrates that pass these performance specifications should be used in dipping vats. We do not suggest any special formulation. Those containing from 50 to 62 percent of toxaphene seem to be satisfactory, and any petroleum solvent within the range of Stoddard's solvent to kerosene should probably suffice. The proper blend of emulsifiers in correct amount seems most important, as hundreds of combinations of anionics and nonionics were tried unsuccessfully at Kerrville and only one passed the performance test. In a stability test 30 days is the minimum laboratory observation period that should be considered, as the emulsion often must be stable in dipping vats for 6 months.

Toxaphene Wettable Powders

Four commercial toxaphene wettable powders, each containing 40 percent of toxaphene, were studied in field and laboratory tests. They were compared with a DDT-BHC wettable powder that is widely sold and has been satisfactory for general use. The specifications as given by the manufacturers varied considerably. All four toxaphene wettable powders gave satisfactory insect control, resuspended normally, and did not cause excessive deposits of toxaphene as measured by analyses of hair from cattle dipped during the 6 months' season.

The average particle size should not greatly exceed 7 microns and at least 98 percent of the powder should pass a 325-mesh sieve. Fuller's earth and other suitable clays are satisfactory diluents. The powder should contain adequate amounts of wetting and dispersing agents.

Laboratory Evaluation

The following laboratory test of the suitability of a toxaphene wettable powder for dipping-vat use is suggested:

Put 3.2 liters of tap water at room temperature into a 1-gallon glass jug. Add wettable powder equivalent to 16 grams of actual toxaphene, pouring the dry powder onto the surface of the water. Without agitation all the powder should become wet and sink below the surface within 10 minutes. It should appear well dispersed after seven inversions of the jug. Do not shake the jug vigorously but merely turn it upside down seven times. The dispersed powder should not flocculate. There should be no appreciable settling during the first 5 minutes after inversion and only about 1/2 inch of sediment after 1 hour. The powder should not cake on standing overnight, but should resuspend as easily as it did 1 hour after mixing.

Use of Insecticides in Dipping Vats

Toxaphene, whether in an emulsifiable concentrate or a wettable powder, should be employed at a concentration of 0.5 percent. DDT in wettable powder should also be used at a concentration of 0.5 percent. For control of lice and horn flies DDT alone is satisfactory, but if animals are being dipped for tick control there should be added enough BHC wettable powder to give 0.025 to 0.03 percent of the gamma isomer. Some manufacturers supply DDT-BHC powders already mixed in the proper proportions.



Thoroughly clean the vat before charging. Fill it with water to a measured line and then add the exact required amount of insecticide. Do not place all the insecticide in one spot. Pour an emulsifiable concentrate uniformly along the full length of the vat and scatter a wettable powder over the surface of the water. Mix the insecticide thoroughly by dragging a bucket on a rope through the vat several times. Dipping should follow immediately. Each time the vat is used for subsequent dippings, remix it in the same way. When it is necessary to prepare more dip to replace that taken out by stock, fill the vat to the dipping line with a measured amount of water and then add sufficient insecticide to compensate for this water.

All dipping vats should be cleaned and freshly charged at the beginning of the dipping season and when they become filthy from continued use. No vat should be used longer than 6 months without cleaning and recharging.

Precautions

Both toxaphene and BHC are toxic to farm animals if applied in excessive amounts. Therefore, all water and insecticides should be carefully measured.

Young animals under 3 months of age and emaciated animals are particularly susceptible to insecticide poisoning, and so should be dipped with special caution.

Toxaphene, DDT, or BHC should not be used on cows giving milk for human consumption.

Dipping vats should be fenced off from adjacent pastures so that livestock cannot drink from a vat or have access to used material removed from a vat.

As the insecticides are toxic to fish, care should be taken that material removed from dipping vats does not pollute streams or ponds.

Literature Cited

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